We claim:

1. An optical evaluation apparatus for use in processing a substrate having a semiconductor region in a chamber, said apparatus comprising:

a first light source for generating exciting light;

a second light source for generating measurement light;

a first light guiding member for intermittently supplying the exciting light generated from said first light source to the semiconductor region of the substrate in said chamber;

a second light guiding member for supplying the measurement light generated from said second light source to said semiconductor region;

reflectance measuring means for measuring a reflectance of the measurement light supplied to said semiconductor region;

a third light guiding member for causing the measurement light reflected from said semiconductor region to be incident upon said reflectance measuring means; and

change calculating means for receiving an output from said reflectance measuring means and calculating a change rate of the reflectance of the measurement light by dividing a difference between the respective reflectances of the measurement light in the presence and absence of said exciting light supplied to said semiconductor region by the reflectance of the measurement light in the absence of the exciting light.

2. An optical evaluation apparatus according to claim 1,

wherein said second light guiding member causes said measurement light to be incident upon a surface of said substrate in a direction approximately perpendicular thereto.

3. An optical evaluation apparatus according to claim 2, wherein said first light guiding member causes said exciting light to be incident upon the surface of said substrate in a direction approximately perpendicular thereto.

4. An optical evaluation apparatus according to claim 3, further comprising

optical axis adjusting means for guiding said exciting light and said measurement light onto a common optical axis before said exciting light and said measurement light is supplied to said semiconductor region, wherein

said second light guiding member is composed of a mirror for supplying the measurement light and exciting light, each guided onto the common optical axis by said optical axis adjusting means, to the surface of said substrate in a direction approximately perpendicular thereto and upwardly transmitting the measurement light and exciting light reflected from said semiconductor region.

5. An optical evaluation apparatus according to claim 1, further comprising spectroscopic means for receiving the measurement light reflected from said semiconductor region, separating said measurement light, and sending the separated measurement light to said reflectance measuring means.

6. An optical evaluation apparatus according to claim 1, wherein said first and second light sources are composed of a single common light source for generating a wide spectrum of light of wavelengths including wavelengths of said exciting light and wavelengths of said measurement light, said apparatus further comprising:

a beam splitter for splitting the wide spectrum of light generated from said common light source into the exciting light and the measurement light; and

spectroscopic means for receiving the measurement light reflected from said semiconductor region, separating said measurement light, and sending the separated measurement light to said reflectance measuring means,

said first and second light guiding members being placed in such a position as to receive the light from said splitter.

7. An optical evaluation apparatus according to claim 1, wherein said change calculating means calculates only the change rate of the reflectance of said measurement light at a specified energy value of the measurement light which provides a near extremal value in a spectrum of the change rate of the reflectance of the measurement light.

8. An optical evaluation apparatus according to claim 1, further comprising

a filter for receiving the measurement light reflected from said semiconductor region, transmitting only the measurement

light of a wavelength in a specified range, and sending the transmitted measurement light to said reflectance measuring means.

9. An optical evaluation apparatus according to claim 7, wherein said specified energy value of the measurement light is any value included in a range of 3.2 to 3.6 eV.

10. An optical evaluation apparatus according to claim 1, wherein said reflectance measuring means measures the reflectance of the light of a wavelength of 600 nm or less.

11. An optical evaluation apparatus according to claim 10, wherein said reflectance measuring means measures the reflectance of the light of a wavelength 300 to 600 nm.

12. An optical evaluation apparatus according to claim 1, wherein said first light guiding member intermittently emits said exciting light at a frequency of 1 kHz or less.

13. An optical evaluation apparatus according to claim 1, said apparatus being constituted by using an ellipsometric spectroscope.

14. An optical evaluation apparatus for evaluating an electric property of an insulating film formed on a semiconductor region of a substrate, said apparatus comprising:

a first light source for generating exciting light;

a second light source for generating measurement light;

a first light guiding member for intermittently supplying the exciting light generated from said first light source and

transmitted by said insulating film to the semiconductor region immediately under the insulating film;

a second light guiding member for supplying the measurement light generated from said second light source and transmitted by said insulating film to the semiconductor region intermittently supplied with said exciting light;

reflectance measuring means for measuring a reflectance of the measurement light supplied to said semiconductor region;

a third light guiding member for causing the measurement light reflected from said semiconductor region to be incident upon said reflectance measuring means;

change calculating means for receiving an output from said reflectance measuring means and calculating a change rate of the reflectance of the measurement light by dividing a difference between the respective reflectances of the measurement light in the presence and absence of said exciting light supplied to said semiconductor region by the reflectance of the measurement light in the absence of the exciting light; and

evaluating means for evaluating the electric property of said insulating film based on the change rate of the reflectance of said measurement light.

15. An optical evaluation apparatus according to claim 14, wherein said evaluating means judges the insulating film to be good only when the change rate of the reflectance of the

measurement light at a specified energy value of the measurement light which provides a near extremal value in a spectrum of the change rate of the reflectance of the measurement light corresponds to a proper capacitance value of the insulating film.

16. An optical evaluation apparatus according to claim 14, wherein said specified energy value of the measurement light is any value included in a range of 3.2 to 3.6 eV.

17. An optical evaluation apparatus according to claim 14, further comprising spectroscopic means for receiving the measurement light reflected from said semiconductor region, separating said measurement light, and transmitting the separated measurement light to said reflectance measuring means.

18. An optical evaluation apparatus according to claim 14, further comprising a filter for receiving the measurement light reflected from said semiconductor region, transmitting only the measurement light of a wavelength in a specified range corresponding to said specified energy value of the measurement light, and sending the transmitted measurement light to said reflectance measuring means.

19. An optical evaluation apparatus according to claim 14, wherein said reflectance measuring means measures the reflectance of the measurement light of a wavelength of 600 nm or less.

20. An optical evaluation apparatus according to claim 19, wherein said reflectance measuring means measures the reflectance of the measurement light of a wavelength of 300 to 600 nm.

21. An optical evaluation apparatus according to claim 14, said apparatus being constituted by using an ellipsometric spectroscope.

22. An optical evaluation apparatus according to claim 14, said apparatus being attached to a chamber used to form an oxide film for a semiconductor device.

23. An optical evaluation apparatus according to claim 14, wherein said second light source is an Xe lamp.

24. An optical evaluation apparatus according to claim 14, wherein said first light source is an Ar ion laser or a He-Ne laser.

25. An optical evaluation apparatus according to claim 14, wherein said first light guiding member intermittently emits said exciting light at a frequency of 1 kHz or less.

26. An apparatus for manufacturing a semiconductor device, said apparatus comprising:

a chamber for containing a substrate having a semiconductor region;

processing means for performing processing with respect to said substrate in said chamber;

first light supplying means for intermittently supplying

exciting light to the semiconductor region of said substrate placed in said chamber;

a second light supplying means for supplying measurement light to said semiconductor region;

reflectance measuring means for measuring a reflectance of the measurement light supplied to said semiconductor region;

change calculating means for receiving an output from said reflectance measuring means and calculating a change rate of the reflectance of the measurement light by dividing a difference between the respective reflectances of the measurement light in the presence and absence of said exciting light supplied to said semiconductor region by the reflectance of the measurement light in the absence of the exciting light; and

processing control means for receiving an output from said change calculating means during the processing performed by said processing means and controlling a condition for said processing based on said change rate of the reflectance.

27. An apparatus for manufacturing a semiconductor device according to claim 26, wherein said processing means generates a plasma in said chamber and performs etching with respect to said semiconductor region by using the generated plasma.

28. An apparatus for manufacturing a semiconductor device according to claim 26, wherein said processing means generates a plasma in said chamber and performs light dry etching by

using the generated plasma so as to remove a damaged layer caused by etching performed with respect to said semiconductor region.

29. An apparatus for manufacturing a semiconductor device according to claim 26, wherein said processing means introduces an impurity into said semiconductor region.

30. An apparatus for manufacturing a semiconductor device according to claim 26, wherein said processing means performs annealing after impurity ions are implanted in said semiconductor region.

31. An apparatus for manufacturing a semiconductor device according to claim 26, wherein said processing means forms a thin insulating film on said semiconductor region.

32. An apparatus for manufacturing a semiconductor device according to claim 26, wherein

a thin insulating film has been formed on said semiconductor region and

said processing means performs dry etching to remove said insulating film from a top surface of said semiconductor region.

33. An apparatus for manufacturing a semiconductor device according to claim 26, wherein an angle formed between said measurement light supplied by said second light supplying means and a surface of said substrate is larger than an angle formed between said exciting light supplied by said first light

supplying means and the surface of said substrate.

34. An apparatus for manufacturing a semiconductor device according to claim 26, wherein said second light supplying means supplies the measurement light to a surface of said substrate in a direction approximately perpendicular thereto.

35. An apparatus for manufacturing a semiconductor device according to claim 34, wherein said first light supplying means supplies the exciting light to the surface of said substrate in a direction approximately perpendicular thereto.

36. An apparatus for manufacturing a semiconductor device according to claim 34, wherein said first light supplying means intermittently emits said exciting light at a frequency of 1 kHz or less.

37. An apparatus for manufacturing a semiconductor device according to claim 26, wherein said second light supplying means and said reflectance measuring means are constituted by using an ellipsometric spectroscope.

38. An optical evaluation method for evaluating processing performed with respect to a substrate having a semiconductor region in a chamber, said method comprising the steps of:

supplying measurement light to the semiconductor region of said substrate in said chamber;

intermittently supplying exciting light to said semiconductor region; and

calculating a change rate of a reflectance of the

measurement light by dividing a difference between the respective reflectances of the measurement light in the presence and absence of said exciting light supplied to said semiconductor region by the reflectance of the measurement light in the absence of the exciting light.

39. An optical evaluation method according to claim 38, wherein said measurement light is supplied to a surface of said substrate in a direction approximately perpendicular thereto in said step of supplying the measurement light.

40. An optical evaluation method according to claim 39, wherein said exciting light is supplied to the surface of said substrate in a direction approximately perpendicular thereto in said step of supplying the exciting light.

Sub a7

41. An optical evaluation method according to claim 38, wherein said processing is a plasma etching process performed with respect to said semiconductor region.

42. An optical evaluation method according to claim 38, wherein said processing is a light dry etching process for removing a damaged layer caused by plasma etching performed with respect to said semiconductor region.

43. An optical evaluation method according to claim 38, wherein said processing is a process of introducing an impurity into said semiconductor region.

44. An optical evaluation method according to claim 38, wherein said processing is an annealing process performed after

impurity ions are implanted in said semiconductor region.

45. An optical evaluation method according to claim 38, wherein said processing is a process of forming an insulating film on said semiconductor region.

46. An optical evaluation method according to claim 38, wherein said processing is a dry etching process for removing an insulating film from a top surface of said semiconductor region.

47. An optical evaluation method according to claim 38, wherein said semiconductor region is composed of n-type silicon.

48. An optical evaluation method according to claim 38, wherein said exciting light is intermittently emitted at a frequency of 1 kHz or less in said step of supplying the exciting light.

49. A method of manufacturing a semiconductor device, said method comprising:

a first step of forming a substrate having a semiconductor region;

a second step of evaluating an optical property of said semiconductor region;

a third step of performing an etching process with respect to said semiconductor region; and

a fourth step of controlling a condition for said etching process based on an optical property of said semiconductor

region evaluated in said second step.

Sub C27

50. A method of manufacturing a semiconductor device according to claim 49, wherein said second step includes the steps of:

supplying measurement light to said semiconductor region;

intermittently supplying exciting light to said semiconductor region; and

calculating a change rate of a reflectance of the measurement light by dividing a difference between the respective reflectances of the measurement light in the presence and absence of said exciting light supplied to said semiconductor region by the reflectance of the measurement light in the absence of the exciting light.

51. A method of manufacturing a semiconductor device according to claim 50, wherein the change rate of the reflectance of the measurement light of a wavelength of 600 nm or less is calculated in said step of calculating the change rate of the reflectance.

52. A method of manufacturing a semiconductor device according to claim 51, wherein the change rate of the reflectance of the measurement light of a wavelength of 300 to 600 nm is calculated in said step of calculating the change rate of the reflectance.

53. A method of manufacturing a semiconductor device according to claim 50, wherein the change rate of the

reflectance of the measurement light at a specified energy value of the measurement light which provides a near extremal value in a spectrum of the change rate of the reflectance of the measurement light is calculated in said step of calculating the change rate of the reflectance.

54. A method of manufacturing a semiconductor device according to claim 53, wherein said specified energy value of the measurement light is any value included in a range of 3.2 to 3.6 eV.

55. A method of manufacturing a semiconductor device according to claim 50, wherein said exciting light is intermittently emitted at a frequency of 1 kHz or less in said step of supplying the exciting light.

56. A method of manufacturing a semiconductor device according to claim 49, wherein dry etching using a plasma is performed in said third step.

57. A method of manufacturing a semiconductor device according to claim 56, said method further comprising, prior to said second step, the steps of:

depositing an interlayer insulating film on said semiconductor region of said substrate; and

selectively removing said interlayer insulating film by plasma etching to form an opening reaching said semiconductor region, wherein

said second step includes evaluating an optical property of

the semiconductor region exposed at a bottom surface of said opening,

said third step includes performing light dry etching with respect to the semiconductor region exposed at the bottom surface of said opening to remove a damaged layer caused by said plasma etching, and

said fourth step includes controlling a condition for the etching process based on a result of evaluating the optical property of said semiconductor region.

58. A method of manufacturing a semiconductor device according to claim 57, wherein

regions of said semiconductor region to be formed with an element are source/drain regions of an FET and

said opening is a contact hole reaching either of said source/drain regions.

59. A method of manufacturing a semiconductor device according to claim 58, wherein

a relationship between the optical property of the semiconductor region and a depth of the damaged layer is predetermined by experiment and

said fourth step includes obtaining the depth of the damaged layer from the optical property of the semiconductor region evaluated in said second step and performing light dry etching to remove a portion of the semiconductor region corresponding to the depth.

Sub E7

60. A method of manufacturing a semiconductor device according to claim 57, wherein said fourth step includes controlling the condition for the etching process by reevaluating the optical property of said semiconductor region which varies with the progression of the light dry etching and comparing a result of reevaluation with a result of evaluation performed in said second step.

61. A method of manufacturing a semiconductor device according to claim 60, wherein

regions of said semiconductor region to be formed with an element are source/drain regions of a FET and

said opening is a contact hole reaching either of said source/drain regions.

Sub C37

62. A method of manufacturing a semiconductor device according to claim 50, said method further comprising, prior to said second step, the steps of:

introducing an impurity at a high concentration into said semiconductor region of said substrate and depositing an interlayer insulating film on said semiconductor region; and

selectively removing said interlayer insulating film by plasma etching to form an opening reaching said semiconductor region, wherein

said third step includes performing light dry etching with respect to the semiconductor region exposed at a bottom surface of said opening to remove a damaged layer caused by said plasma

etching and predetermining a proper range of the change rate of the reflectance of said measurement light when an electric property of the semiconductor region is proper and

said fourth step includes performing said light dry etching such that said change rate of the reflectance falls within said proper range.

63. A method of manufacturing a semiconductor device according to claim 49, wherein

said first step includes forming, as said semiconductor region, a first semiconductor region forming a part of a semiconductor element and a second semiconductor region to be subjected to optical evaluation,

said second step includes evaluating the optical property of said second semiconductor region,

said third step includes performing the etching process with respect to said first and second semiconductor regions simultaneously, and

said fourth step includes controlling the condition for said etching process based on the result of evaluating the optical property of said second semiconductor region.

64. A method of manufacturing a semiconductor device according to claim 63, wherein said first step includes adjusting an impurity concentration in said second semiconductor region to be higher than an impurity concentration in said first semiconductor region.

65. A method of manufacturing a semiconductor device according to claim 63, said method further comprising, prior to said second step, the step of

introducing an impurity at a high concentration into said second semiconductor region of said substrate and depositing a gate insulating film and a conductive film for a gate electrode on said first and second semiconductor regions, wherein

said third step includes patterning said conductive film for a gate electrode and said gate insulating film by plasma etching and predetermining a proper range of a change rate of a reflectance of said measurement light when an electric property of the semiconductor region is proper and

said fourth step includes performing said light dry etching such that said change rate of the reflectance falls within said proper range.

Sub E

66. A method of manufacturing a semiconductor device according to claim 65, wherein a silicon oxide film is formed as said gate insulating film.

D6

67. A method of manufacturing a semiconductor device according to claim 49, wherein said first step includes composing a portion of said semiconductor region to be subjected to optical evaluation of n-type silicon.

Sub C4

68. A method of manufacturing a semiconductor device according to claim 50, wherein said second step includes evaluating the change rate of the reflectance of measurement

light by using an ellipsometric spectroscope.

69. A method of manufacturing a semiconductor device having a semiconductor region with a structural disorder developed therein, said method comprising the steps of:

evaluating an optical property of said semiconductor region; and

performing a heat treatment for recovering said semiconductor region from the structural disorder, while controlling a condition for the heat treatment based on the optical property of said semiconductor region evaluated in said foregoing step.

70. A method of manufacturing a semiconductor device according to claim 69, wherein said step of evaluating the optical property includes the steps of:

supplying measurement light to said semiconductor region;

intermittently supplying exciting light to said semiconductor region; and

calculating a change rate of a reflectance of the measurement light by dividing a difference between the respective reflectances of the measurement light in the presence and absence of said exciting light supplied to said semiconductor region by the reflectance of the measurement light in the absence of the exciting light.

71. A method of manufacturing a semiconductor device according to claim 70, wherein the change rate of the

reflectance of the measurement light of a wavelength of 600 nm or less is calculated in said step of calculating the change rate of the reflectance.

72. A method of manufacturing a semiconductor device according to claim 71, wherein the change rate of the reflectance of the measurement light of a wavelength of 300 to 600 nm is calculated in said step of calculating the change rate of the reflectance.

Sub C5

73. A method of manufacturing a semiconductor device according to claim 70, wherein the change rate of the reflectance of the measurement light at a specified energy value of the measurement light which provides a near extremal value in a spectrum of the change rate of the reflectance of the measurement light is calculated in said step of calculating the change rate of the reflectance.

74. A method of manufacturing a semiconductor device according to claim 71, wherein said specified energy value of the measurement light is any value included in a range of 3.2 to 3.6 eV.

75. A method of manufacturing a semiconductor device according to claim 70, wherein said exciting light is intermittently emitted at a frequency of 1 kHz or less in said step of supplying the exciting light.

76. A method of manufacturing a semiconductor device according to claim 70, wherein

a proper range of the change rate of the reflectance of said measurement light when an electric property of the semiconductor region is proper is predetermined and

said heat treatment is performed in said step of performing the heat treatment with respect to the semiconductor region such that the change rate of the reflectance of said measurement light falls within said proper range.

77. A method of manufacturing a semiconductor device according to claim 70, wherein

a relationship between the change rate of the reflectance of the measurement light in said semiconductor region and an impurity concentration in said semiconductor region is predetermined and

the heat treatment is performed with respect to said semiconductor device in said step of performing the heat treatment till the change rate of the reflectance of the measurement light in said semiconductor region reaches a value corresponding to a desired impurity concentration.

78. A method of manufacturing a semiconductor device according to claim 69, wherein

a first semiconductor region forming a part of a semiconductor element and a second semiconductor region to be subjected to optical evaluation are preliminarily formed as said semiconductor region,

the optical property of said second semiconductor region is

evaluated in said step of evaluating the optical property, and said first and second semiconductor regions are simultaneously subjected to the heat treatment in said step of performing the heat treatment, while a condition for said heat treatment is controlled based on the result of evaluating the optical property of said second semiconductor region.

79. A method of manufacturing a semiconductor device according to claim 78, wherein said first step includes adjusting an impurity concentration in said second semiconductor region to be higher than an impurity concentration in said first semiconductor region.

80. A method of manufacturing a semiconductor device according to claim 69, wherein a portion of said semiconductor region to be subjected to optical evaluation is composed of n-type silicon.

81. A method of manufacturing a semiconductor device according to claim 69, wherein regions of said semiconductor region to be formed with a semiconductor element are source/drain regions.

82. A method of manufacturing a semiconductor device according to claim 70, wherein said second step includes evaluating the change rate of the reflectance of the measurement light by using an ellipsometric spectroscope.

83. A method of manufacturing a semiconductor device having a semiconductor region, said method comprising the steps of:

evaluating an optical property of said semiconductor region; and

introducing an impurity into said semiconductor region, while controlling a condition for the impurity introduction based on the optical property of said semiconductor region evaluated in said foregoing step.

Sub C7

84. A method of manufacturing a semiconductor device according to claim 83, wherein said step of evaluating the optical property includes the steps of:

supplying measurement light to said semiconductor region;

intermittently supplying exciting light to said semiconductor region; and

calculating a change rate of a reflectance of the measurement light by dividing a difference between the respective reflectances of the measurement light in the presence and absence of said exciting light supplied to said semiconductor region by the reflectance of the measurement light in the absence of the exciting light.

85. A method of manufacturing a semiconductor device according to claim 84, wherein the change rate of the reflectance of the measurement light of a wavelength of 600 nm or less is calculated in said step of calculating the change rate of the reflectance.

86. A method of manufacturing a semiconductor device according to claim 85, wherein the change rate of the

reflectance of the measurement light of a wavelength of 300 to 600 nm is calculated in said step of calculating the change rate of the reflectance.

87. A method of manufacturing a semiconductor device according to claim 84, wherein the change rate of the reflectance of the measurement light at a specified energy value of the measurement light which provides a near extremal value in a spectrum of the change rate of the reflectance of the measurement light is calculated in said step of calculating the change rate of the reflectance.

88. A method of manufacturing a semiconductor device according to claim 87, wherein said specified energy value of the measurement light is any value included in a range of 3.2 to 3.6 eV.

89. A method of manufacturing a semiconductor device according to claim 84, wherein said exciting light is intermittently emitted at a frequency of 1 kHz or less in said step of supplying the exciting light.

90. A method of manufacturing a semiconductor device according to claim 84, wherein

a relationship between an amount of introduced impurity and the change rate of the reflectance of said measurement light is predetermined by experiment and

said impurity is introduced in said step of introducing the impurity into said semiconductor region such that the change

rate of the reflectance of said measurement light reaches a value corresponding to a desired amount of introduced impurity.

91. A method of manufacturing a semiconductor device according to claim 83, wherein

a first semiconductor region forming a part of a semiconductor element and a second semiconductor region to be subjected to optical evaluation are preliminarily formed as said semiconductor region,

the optical property of said second semiconductor region is evaluated in said step of evaluating the optical property, and

the impurity is introduced into said first and second semiconductor regions simultaneously in said step of introducing the impurity, while a condition for the impurity introduction is controlled based on the result of evaluating the optical property of said second semiconductor region.

92. A method of manufacturing a semiconductor device according to claim 83, wherein said third step includes introducing said impurity by plasma doping.

93. A method of manufacturing a semiconductor device according to claim 83, wherein said impurity is an n-type impurity.

94. A method of manufacturing a semiconductor device according to claim 83, wherein regions of said semiconductor region to be formed with a semiconductor element are source/drain regions.

Sub C9

95. A method of manufacturing a semiconductor device according to claim 84, wherein said second step includes evaluating the change rate of the reflectance of the measurement light by using an ellipsometric spectroscope.

Sub E

96. A method of manufacturing a semiconductor device, said method comprising:

a first step of forming a substrate having a semiconductor region;

a second step of evaluating an optical property of said semiconductor region;

a third step of forming a thin insulating film on said semiconductor region; and

a fourth step of controlling a condition for the formation of said insulating film based on the optical property of said semiconductor region evaluated in said second step.

Sub C10

97. A method of manufacturing a semiconductor device according to claim 96, wherein said second step includes the steps of:

supplying measurement light to said semiconductor region;

intermittently supplying exciting light to said semiconductor region; and

calculating a change rate of a reflectance of the measurement light by dividing a difference between the respective reflectances of the measurement light in the presence and absence of said exciting light supplied to said

semiconductor region by the reflectance of the measurement light in the absence of the exciting light.

98. A method of manufacturing a semiconductor device according to claim 97, wherein the change rate of the reflectance of the measurement light of a wavelength of 600 nm or less is calculated in said step of calculating the change rate of the reflectance.

99. A method of manufacturing a semiconductor device according to claim 98, wherein the change rate of the reflectance of the measurement light of a wavelength of 300 to 600 nm is calculated in said step of calculating the change rate of the reflectance.

100. A method of manufacturing a semiconductor device according to claim 97, wherein the change rate of the reflectance of the measurement light at a specified energy value of the measurement light which provides a near extremal value in a spectrum of the change rate of the reflectance of the measurement light is calculated in said step of calculating the change rate of the reflectance.

101. A method of manufacturing a semiconductor device according to claim 100, wherein said specified energy value of the measurement light is any value included in a range of 3.2 to 3.6 eV.

102. A method of manufacturing a semiconductor device according to claim 97, wherein said exciting light is

intermittently emitted at a frequency of 1 kHz or less in said step of supplying the exciting light.

Sub C11

103. A method of manufacturing a semiconductor device according to claim 97, wherein

a proper range of the change rate of the reflectance of the measurement light when an electric property of the insulating film is proper is predetermined by experiment and

said fourth step includes forming the insulating film such that the change rate of the reflectance of the measurement light measured in said second step falls within said proper range.

104. A method of manufacturing a semiconductor device according to claim 97, wherein

said second step includes measuring the change rate of the reflectance of the measurement light in the semiconductor region before said insulating film is formed thereon and

said fourth step includes controlling a condition for the formation of the insulating film by remeasuring the change rate of the reflectance of the measurement light in said semiconductor region which varies with the progression of the formation of the insulating film and comparing a result of remeasurement with a result of measurement performed in said second step.

Sub E2

105. A method of manufacturing a semiconductor device according to claim 96, wherein

said first step includes forming, as said semiconductor region, a first semiconductor region forming a part of a semiconductor element and a second semiconductor region to be subjected to optical evaluation,

Sub E7

said second step includes evaluating the optical property of said second semiconductor region,

said third step includes forming the insulating film on said first and second semiconductor regions simultaneously, and

said fourth step includes controlling a condition for the formation of said insulating film based on the result of evaluating the optical property of said second semiconductor region.

106. A method of manufacturing a semiconductor device according to claim 105, wherein said first step includes adjusting an impurity concentration in said second semiconductor region to be higher than an impurity concentration in said first semiconductor region.

107. A method of manufacturing a semiconductor device according to claim 96, wherein said first step includes composing a portion of said semiconductor region to be subjected to optical evaluation of n-type silicon.

Sub C12

108. A method of manufacturing a semiconductor device according to claim 97, said method further comprising, after said fourth step, the step of

judging the formed insulating film to be good or no good

based on a relationship predetermined by experiment between the change rate of the reflectance of said measurement light and an electric property of the insulating film.

109. A method of manufacturing a semiconductor device according to claim 96, wherein a silicon oxide film is formed as said insulating film in said third step.

110. A method of manufacturing a semiconductor device according to claim 96, wherein a gate insulating film is formed as said insulating film in said third step.

111. A method of manufacturing a semiconductor device according to claim 97, wherein said second step includes evaluating the change rate of the reflectance of the measurement light by using an ellipsometric spectroscope.

112. A method of manufacturing a semiconductor device, said method comprising:

a first step of forming a substrate having a semiconductor region and a thin insulating film overlying the semiconductor region;

a second step of evaluating an optical property of said semiconductor region;

a third step of removing said insulating film by dry etching; and

a fourth step of controlling a condition for the removal of said insulating film based on the optical property of said semiconductor region evaluated in said second step.

Sub a4 113. A method of manufacturing a semiconductor device according to claim 112, wherein said second step includes the steps of:

supplying measurement light to said semiconductor region through said insulating film;

intermittently supplying exciting light to said semiconductor region through said insulating film; and

calculating a change rate of a reflectance of the measurement light by dividing a difference between the respective reflectances of the measurement light in the presence and absence of said exciting light supplied to said semiconductor region by the reflectance of the measurement light in the absence of the exciting light.

114. A method of manufacturing a semiconductor device according to claim 113, wherein the change rate of the reflectance of the measurement light of a wavelength of 600 nm or less is calculated in said step of calculating the change rate of the reflectance.

115. A method of manufacturing a semiconductor device according to claim 114, wherein the change rate of the reflectance of the measurement light of a wavelength of 300 to 600 nm is calculated in said step of calculating the change rate of the reflectance.

116. A method of manufacturing a semiconductor device according to claim 113, wherein the change rate of the

reflectance of the measurement light at a specified energy value of the measurement light which provides a near extremal value in a spectrum of the change rate of the reflectance of the measurement light is calculated in said step of calculating the change rate of the reflectance.

117. A method of manufacturing a semiconductor device according to claim 116, wherein said specified energy value of the measurement light is any value included in a range of 3.2 to 3.6 eV.

118. A method of manufacturing a semiconductor device according to claim 113, wherein said exciting light is intermittently emitted at a frequency of 1 kHz or less in said step of supplying the exciting light.

119. A method of manufacturing a semiconductor device according to claim 113, wherein

a proper range of the change rate of the reflectance of the measurement light when the removal of said insulating is properly completed is predetermined and

said fourth step includes performing dry etching with respect to the insulating film such that the change rate of the reflectance of the measurement light measured in said second step falls within said proper range.

120. A method of manufacturing a semiconductor device according to claim 113, wherein

said second step includes measuring the change rate of the

reflectance of the measurement light in the semiconductor region when said insulating film is formed thereon and

said fourth step includes controlling a condition for the removal of the insulating film by remeasuring the change rate of the reflectance of the measurement light in said semiconductor region which varies with the progression of the removal of the insulating film and comparing a result of remeasurement with a result of measurement performed in said second step.

121. A method of manufacturing a semiconductor device according to claim 112, wherein

said first step includes forming, as said semiconductor region, a first semiconductor region forming a part of a semiconductor element and a second semiconductor region to be subjected to optical evaluation,

said second step includes evaluating the optical property of said second semiconductor region,

said third step includes performing an etching process with respect to said first and second semiconductor regions simultaneously, and

said fourth step includes controlling a condition for said etching process based on the result of evaluating the optical property of said second semiconductor region.

122. A method of manufacturing a semiconductor device according to claim 121, wherein said first step includes

adjusting an impurity concentration in said second semiconductor region to be higher than an impurity concentration in said first semiconductor region.

Sub B7

123. A method of manufacturing a semiconductor device according to claim 112, wherein said first step includes composing a portion of said semiconductor region to be subjected to optical evaluation of n-type silicon.

124. A method of manufacturing a semiconductor device according to claim 112, wherein a silicon oxide film is formed as said insulating film in said first step.

125. A method of manufacturing a semiconductor device according to claim 112, wherein a gate insulating film is formed as said insulating film in said first step.

126. A method of manufacturing a semiconductor device according to claim 125, wherein

said first step includes forming a conductive film for a gate electrode on said gate insulating film and

said third step includes sequentially patterning said conductive film for a gate electrode and said gate insulating film.

Sub C16

127. A method of manufacturing a semiconductor device according to claim 113, wherein said second step includes evaluating the change rate of the reflectance of the measurement light by using an ellipsometric spectroscope.

128. A method of controlling an apparatus for manufacturing

a semiconductor device comprising a chamber for containing a substrate having a semiconductor region, processing means for performing processing with respect to said substrate in said chamber, first light supplying means for intermittently supplying exciting light to the semiconductor region of said substrate placed in said chamber, a second light supplying means for supplying measurement light to said semiconductor region, and reflectance measuring means for measuring a reflectance of the measurement light supplied to said semiconductor region, said method comprising:

a first step of supplying the measurement light to said semiconductor region;

a second step of intermittently supplying the exciting light to said semiconductor region;

a third step of calculating a change rate of the reflectance of the measurement light by dividing a difference between the respective reflectances of the measurement light in the presence and absence of said exciting light supplied to said semiconductor region by the reflectance of the measurement light in the absence of the exciting light;

a fourth step of operating said processing means for a specified time till the change rate of the reflectance calculated in said third step reaches a specified value; and

a fifth step of monitoring said specified time in said fourth step and outputting a signal for causing maintenance to

be performed with respect to said apparatus for manufacturing the semiconductor device when said specified time exceeds a limit value.

129. A method of controlling an apparatus for manufacturing a semiconductor device according to claim 128, wherein said processing means generates a plasma in said chamber and performs etching with respect to said semiconductor region by using the generated plasma.

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130. A method of controlling an apparatus for manufacturing a semiconductor device according to claim 128, wherein said processing means generates a plasma in said chamber and performs light dry etching by using the generated plasma so as to remove a damaged layer caused by etching performed with respect to said semiconductor region.

131. A method of controlling an apparatus for manufacturing a semiconductor device according to claim 128, wherein said processing means introduces an impurity into said semiconductor region.

132. A method of controlling an apparatus for manufacturing a semiconductor device according to claim 128, wherein said processing means performs annealing after impurity ions are implanted in said semiconductor region.

133. A method of controlling an apparatus for manufacturing a semiconductor device according to claim 128, wherein said processing means forms a thin insulating film on said

semiconductor region.

134. A method of controlling an apparatus for manufacturing a semiconductor device according to claim 128, wherein

a thin insulating film has been formed on said semiconductor region and

said processing means performs dry etching to remove said insulating film from a top surface of said semiconductor region.

135. A method of controlling an apparatus for manufacturing a semiconductor device according to claim 128, wherein said reflectance measuring means measures the reflectance of the measurement light of a wavelength of 600 nm or less.

136. A method of controlling an apparatus for manufacturing a semiconductor device according to claim 135, wherein said reflectance measuring means measures the reflectance of the measurement light of a wavelength of 300 to 600 nm.

137. A method of controlling an apparatus for manufacturing a semiconductor device according to claim 128, wherein the change rate of the reflectance of the measurement light at a specified energy value of the measurement light which provides a near extremal value in a spectrum of the change rate of the reflectance of the measurement light is calculated in said step of calculating the change rate of the reflectance.

138. A method of controlling an apparatus for manufacturing a semiconductor device according to claim 128, wherein said

reflectance measuring means measures the reflectance of the reflected light of a specified wavelength by using an optical filter.

139. A method of controlling an apparatus for manufacturing a semiconductor device according to claim 128, wherein said semiconductor region is composed of n-type silicon.

140. A method of controlling an apparatus for manufacturing a semiconductor device according to claim 128, wherein said exciting light is intermittently emitted at a frequency of 1 kHz or less in said step of supplying the exciting light.

141. A semiconductor device comprising:

a substrate;

a first semiconductor region provided in a top surface of said substrate to form a part of a semiconductor element to be formed on the substrate; and

a second semiconductor region having an optical property monitored during processing performed in said first semiconductor region.

142. A semiconductor device according to claim 141, wherein said second semiconductor region is provided in a region other than a region to be formed with a semiconductor chip including said semiconductor element.

143. A semiconductor device according to claim 142, wherein said second semiconductor region is provided in the region to be formed with the semiconductor chip including said

semiconductor element.

144. A semiconductor device according to claim 141, wherein said second semiconductor region is composed of a semiconductor material to be used for monitoring by optical-modulation reflectance spectrophotometry.

145. A semiconductor device according to claim 141, wherein said second semiconductor region is composed of n-type silicon.